GEI-21161

GENERAL ELECTRIC

INSTRUCTIONS

WATERWHEEL-DRIVEN ALTERNATING-CURRENT GENERATOR

Rated

ATI-W - 48 Poles - 32,000 KVA -
125 RPM - 13,800 VOLTS
Serial Number 5690886

Unidad II

falta:
Instructions
Direct connected exciter, (GEH-[illegible])
(General Electric)

FN-412-A (5-38)

INSTRUCTIONS

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ATI-W-48 Poles-32,000 KVA-125 RPM-13,800 Volts

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CONTRACT IGE-670

COMISION TECNICA Y FINANCIERA
DE LAS OBRAS HIDROELECTRICAS
DEL RIO NEGRO (RIONE), URUGUAY
G-E REQ. I-56200

GENERAL ELECTRIC COMPANY
SCHENECTADY, NEW YORK

3-45 (14)

CONTENTS

Subject	Page
List of Enclosures	3
Introduction	5
Assembly of Stator Coils	5
Identification of Parts.	7
Assembly of Poles	7
Assembly of Rotor and Supporting Structure on Foundation	8
Dismantling of Rotor and Lower Bearing Bracket . .	9
Combined Brakes and Jacks.	10
Lubrication System.	10

LIST OF ENCLOSURES

PHOTOGRAPHS

607207 - Shaft (In Lathe)
607208 - Shaft (In Lathe)
608005 - Trial Assembly of Poles and Fans on Section of Rotor Rim.
608846 - Part View of Top of Ventilating Housing
608847 - Ventilating Housing Assembled

609127 - Piping and Valves for Water Supply to Fire Extinguisher and Duct for Kaplan Pipes.
609128 - Surface Air Cooler and Support Mounted on Stator Frame.
610050 - Current Transformers Assembled on Main and Neutral Leads.
610051 - Current Transformers Assembled on Main and Neutral Leads.
610377 - Part View of Lower Bearing Bracket Showing Brakes, Piping, Etc.

610378 - Part View of Lower Bearing Bracket Showing Brakes, Piping, Etc.
610769 - Part View of Lower Bearing Bracket and Bearing Oil Cooler.
610770 - Part View of Lower Bearing Bracket with Misc. Piping and Accessories
610771 - Control Panel for Circulating Oil Pumps.
610860 - Lifting Beam and Links for Lower Bearing Bracket and Shaft.

610861 - Lifting Beam and Links for Lower Bearing Bracket and Shaft.

INSTRUCTION BOOKS

GEH-527C - Vertical Waterwheel-driven Generators
GEH-67G - Direct-connected Exciters
GEI-7173A - Terminal Board for Resistance Temperature Detectors
GEH-562C - Surface Air and Gas Coolers
GEI-13538A - Temperature Relays, Type TB-9

DRAWINGS

The following drawings are being supplied in accordance with the terms of the contract. They are not included as part of this book.

W-8008187 - Outline
W-9016535 - Assembly
T-8605600 - Rotor Lifting Device
P-8297251 - Outline (Air Cooler)
K-8635254 - Material List

T-8605644 - Removal of Thrust Brg.
W-5939593 - Piping (Air Cooler)
P-8294901 - Lifting Device (Shaft)
T-8605808 - Lifting Device (Brkt. & Shaft)
T-8605918 - Assem. of Oil Cooler & Pumps

W-8676787 - Stator Connections
T-9011016 - Pedestal (For Rotor)
P-8295297 - Terminal Boxes
T-9011028 - Brake Piping
K-8279873 - Jacking Pump

T-9011046 - Exciter Lighting
W-8676791 - Cover Plates (Lower)
W-9016501 - Cover Plates (Upper)
W-9016503 - Vent. Housing
P-8295330 - Heaters

W-8676798 - Instruments & Accs.
W-9016551 - Piping Plan
W-9016553 - Fire Extinguisher
T-9011124 - Diag. of Connections
T-9011205 - Stairway

T-9011232 - Wrench Board
P-8299373 - Wiring Diag. (Control Panel)
K-8698184 - Guide Pins
T-8605833 - Rotor Connections & Accessories
T-9011087 - Stator Coil Diag.

T-8605637 - Shaft
T-8005739 - Guide Bearing (Upper)
T-8605990 - Guide Bearing (Lower)
T-3695975 - Brake & Jack
P-8295376 - Stationary Ring
P-8295414 - Gaskets
M-1131479 - Method of Assembling Field Coils

INTRODUCTION

It is recommended that the erection of units of this size and importance should only be undertaken under the supervision of a competent erecting engineer experienced in installing large rotating apparatus.

It is obviously impossible to give written instructions that will cover all the questions that will arise in an undertaking of this kind, and the purpose of these instructions is merely to supplement the general information given in Instruction GEH-527C and others included herewith, by a few additional details which may be helpful in the erection or repair of this generator.

ASSEMBLY OF STATOR COILS

Joints in the steel rings which support the ends of the stator coils should be insulated as follows. Reinforce with three or four layers of 0.005 in. paper-backed mica sheet. Then apply three courses of insulation, each course consisting of four tapings of 0.005 in. paper-backed mica tape and one taping of 0.005 in. treated glass tape, each half-lapped and applied with G-E compound No. 1028 (insulating varnish).

Before installing joint coils or when replacing damaged coils it will be necessary to raise a few adjacent coils from the slots. Before the factory-assembled coils are moved or the loose coils inserted in the slots, they must be heated to make the insulation flexible so that it will not be damaged in handling. Coils should be heated by direct current of such an amount as to slowly raise the temperature, measured by thermometer on the outside of the coil, to 70 or 80 C. About 280 amperes should be sufficient.

Standard motor-driven welding sets can be used to furnish direct current for heating the coils. It should be remembered that the current capacity of welding generators is an intermittent rating and that the generators will not supply full current capacity for any appreciable time without dangerous heating. However, any number of welding generators can be operated in parallel, IF THEY ARE BROUGHT UP TO VOLTAGE BEFORE BEING CONNECTED IN PARALLEL.

Coils or leads (ends of coils) must never be disturbed or bent when cold, as injury to the insulation will result. The coils should not be heated more than necessary and should not be heated too rapidly, as this might cause the insulation to bulge away from the copper. All wedges should be driven while the coils are hot.

After the joint coils have been installed, the factory coils replaced and the wedges driven, but before any connections are made, the unconnected coils should be tested at 28,600 volts to ground. The parts of the winding in which the connections are complete should be grounded during this test.

The connections are to be made in accordance with the stator-coil diagram, T-9011087 Pt.1.

The series connections (that is, the short connections between two adjacent coils in the same phase group) should be insulated as follows: Apply three courses of insulation, each course consisting of three tapings of 0.006 in. cloth-backed mica tape and one taping of 0.005 in. treated glass tape, each half-lapped and applied with G-E Compound No. 1028.

Other soldered joints and the joints between the machine terminals and customer's terminals should be insulated as follows: Apply three courses of insulation, each consisting of four tapings of 0.005 in. paper-backed mica tape and one taping of 0.005 in. treated glass tape, each half-lapped and applied with G-E Compound No. 1028.

Care should be taken to have the tape applied evenly and tightly and to have the varnish uniformly spread to fill all interstices. The finished connections should be thoroughly sprayed with G-E Compound No. 183 or 7133 (insulating varnishes).

IDENTIFICATION OF PARTS

In the factory assembly and fitting of parts, the major parts were marked with the serial number of the stator and an arrow on the "radial assembly line", shown on the outline drawing. Most parts were also match-marked to facilitate reassembly at destination. This match-marking starts at the first joint clockwise from the assembly line and the joints are numbered consecutively in a clockwise direction, looking down on the machine. It should be noted that the "radial assembly line" shown on the outline drawing is a radius and not a diameter.

ASSEMBLY OF POLES:

Trial assembly of poles on a built up section of rotor spider rim is shown on Photograph 608005. On these trial poles, all pole keys were fitted in matched pairs and numbered in accordance with the method shown on Drawing M-1131479 Pt. 4, in order to facilitate final assembly in the field.

Ten coil springs are provided for each pole, to be inserted in holes in the rotor spider to keep the coils and insulating collars tight against the pole tip. These springs bear against a steel collar assembled at the bottom of the pole as a protection to the insulating collar.

The connections between field coils should be brazed by means of the brazing outfit supplied with the generator.

Care should be taken to see that all bolts and nuts on rotating parts are securely locked by means of the lock-washers provided, or by tack welding.

ASSEMBLY OF ROTOR AND SUPPORTING STRUCTURE ON FOUNDATION

In making the initial assembly of the lower bearing bracket, shaft, bearings, etc., cribbing should be assembled on El. 64.90 to support the complete assembly at the ends of the main beams of the bearing bracket. This cribbing should be approximately eight feet high and be able to support a load of 125 tons.

The servomotor adapter flange should be set under the center line of the bracket so it can be bolted to the coupling of the generator shaft, after the shaft has been placed in position in the bracket. The thrust and guide bearings, cover plates, brakes and piping can now be assembled.

By using the lifting beam and one set of links as shown on Drawing T-8605808 and Photograph 610861, the complete assembly can be lifted and placed in position except for being set on 12 in. blocks. The lifting links must now be removed so that the Kaplan pipes can be assembled in the shaft and the inner pipe connected to the piston of the servomotor. The double set of links, as shown on Drawing T-8605808, are next assembled on the bracket. Then lift the assembly slightly to remove the 12 in. blocks and lower the bracket onto the jack bolts provided in the ends of the main beams of the bracket.

After aligning and closing the coupling between the turbine and generator shafts the chocks at the ends of the main beams of the bearing bracket should be fitted.

The assembled rotor can then be lifted by means of the equalizing beam and lifting bell and placed in position on the shaft. After the bolts between the rotor plates and the shaft flanges have been assembled, the two pinned side arms should be adjusted so that when the weight of the rotating element is in the blocked position, the two hydraulic jacks on the side arms will carry their proportional part of the weight. With the weight of the rotating element on the thrust bearing, the chocks under the side arms should be fitted, and all of the dowels between the bracket and pit liner assembled.

DISMANTLING OF ROTOR AND LOWER BEARING BRACKET

If it becomes necessary to remove the turbine runner, the following is a brief dismantling procedure for the generator.

After the oil head, exciters, upper bearing bracket, and the bolts between the rotor plates and the shaft flanges have been removed, the equalizing beam with the lifting bell should be used to remove the assembled rotor and place it on the rotor pedestal.

The coupling bolts between the servomotor and the servomotor adapter flange can be removed at the same time, lowering the turbine runner and shaft onto its support. The holding-down bolts for the lower bearing bracket should be removed and replaced with the guide pins as shown in Drawing K-8698184. The lifting device for the lower bearing bracket, using the double set of links, as shown in Drawing T-8605808, should be assembled on the bracket. The assembly then should be lifted approximately 12 in. and blocked in this position. After removing the lifting links, the inner oil pipe can be disconnected from the servomotor piston and both the inner and outer pipes removed from the shaft. The bearing-bracket lifting device should next be reassembled using the single set of links as shown on Photograph 610861. The complete assembly now can be removed and placed on a cribbing built up as indicated for the initial assembly.

COMBINED BRAKES AND JACKS

This generator is equipped with six combined brakes and jacks, only four of which, mounted on the two main girders, are used for braking purposes. The two additional ones, one mounted on each side arm of the bracket, are for equalizing the jacking load.

See the instructions for operation of brakes and jacks in Instructions GEH-527C (page 16) a copy of which follows this text.

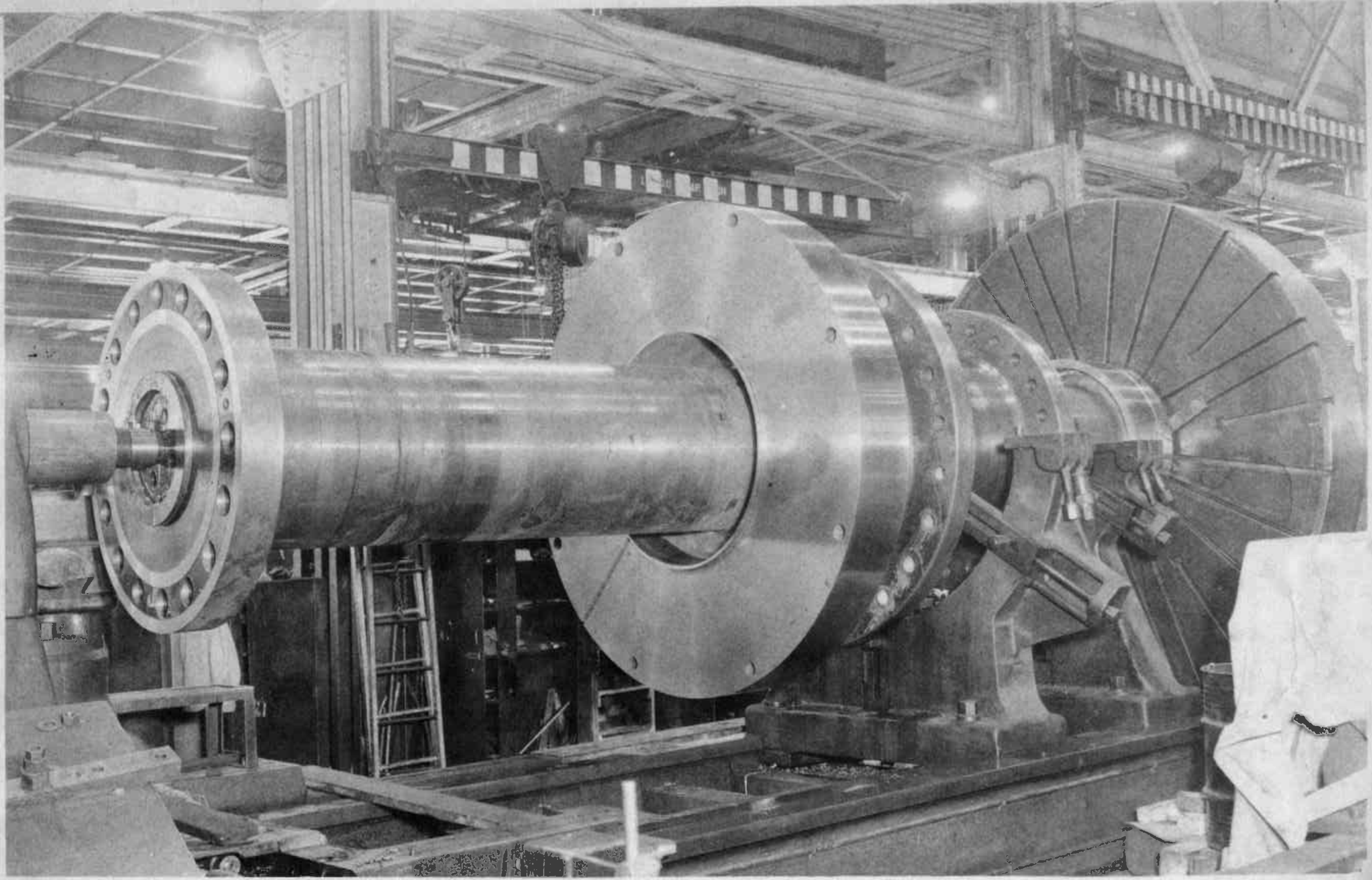
LUBRICATION SYSTEM

In connection with the lubrication system for the thrust bearing and lower guide bearing located in the thrust-bearing housing, reference can be made to Photographs 610771 and 610769, and to Drawing W-9016551 and T-8605819. The thrust-bearing housing, oil cooler and connecting piping should be filled with oil to the elevation shown on the outline drawing, while the generator is at rest. Two centrifugal pumps are provided to circulate the oil from the thrust-bearing housing through the heat exchanger and back to the bearings. The a-c motor-driven pump is for normal operation and the d-c pump for emergency use, if there is a failure of the a-c driven unit.

There is a valve on the suction side of each pump which always must be open, except when one pump is to be removed for repairs.

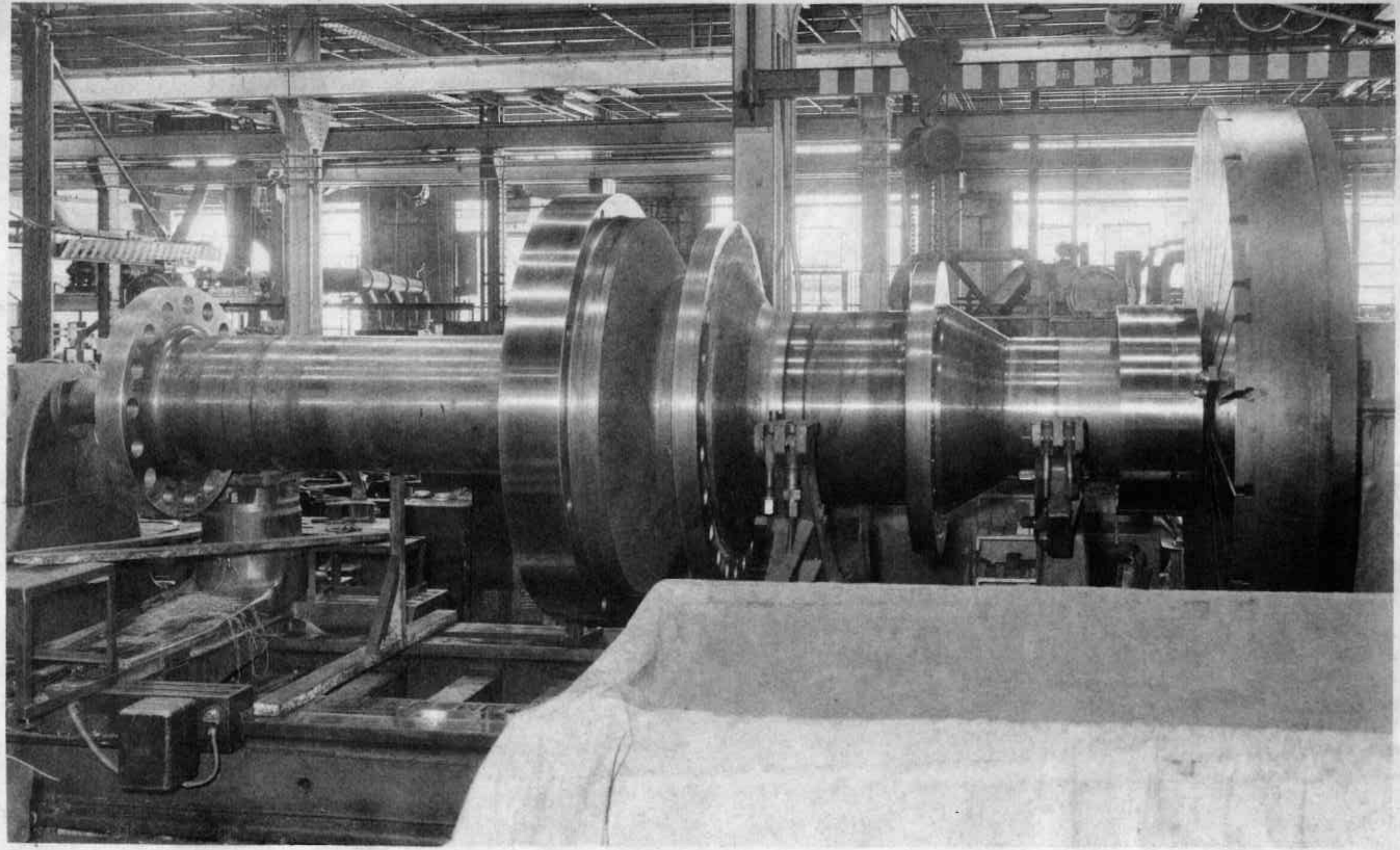
The pressure governor on the control panel was adjusted at the factory to automatically start the d-c motor driven pump if the oil pressure drops below 10 lb per square in. To check the setting of the governor, cut down the flow of oil temporarily by gradually closing the valve on the suction of the a-c motor-driven pump.

It should be noted that the gage on the pressure governor does not show the pressures from the d-c motor-driven pump.



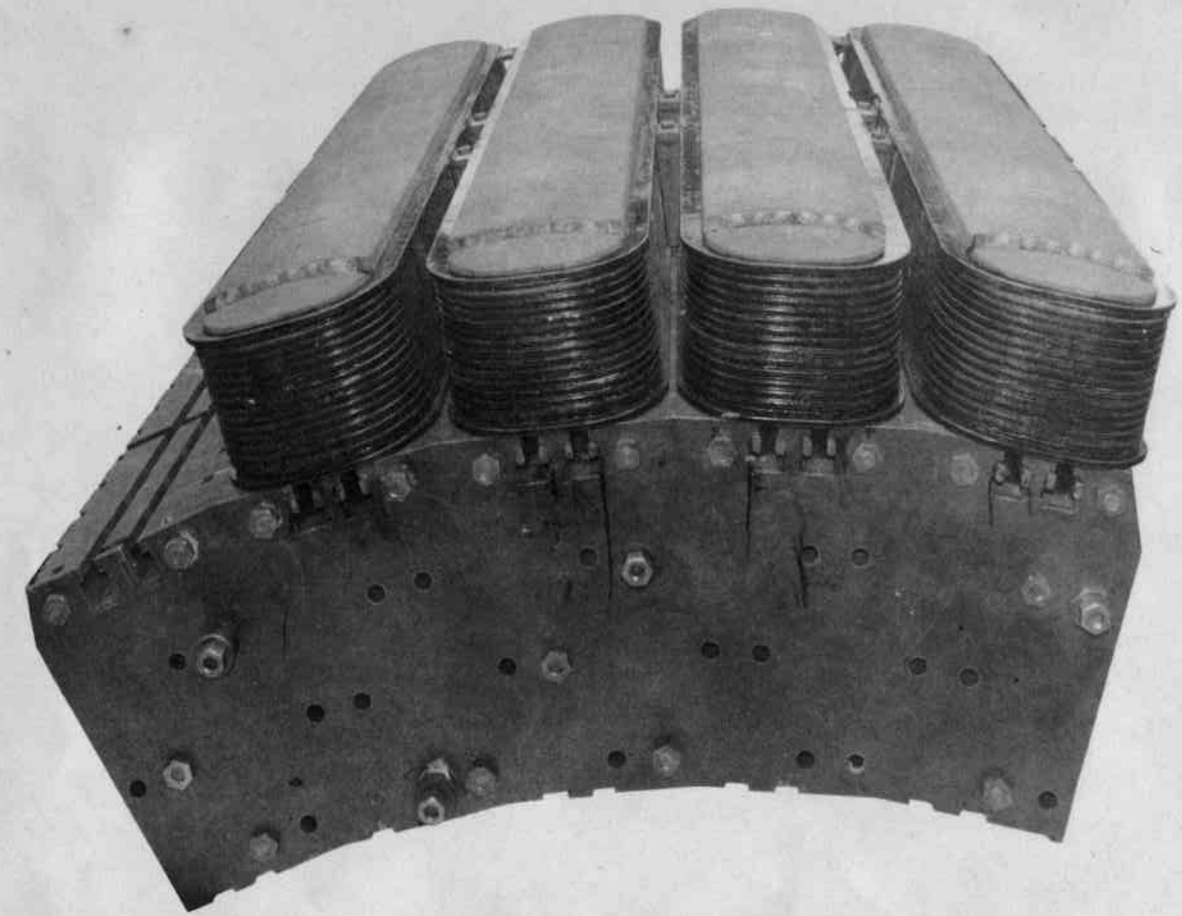
607 207 SHAFT (IN LATHE) FOR VERTICAL WATERWHEEL SYNCHRONOUS A-C GENERATOR,
32,000-KVA, 125-RPM, 13,800-VOLT, 50-CYCLE, 48-POLE, TYPE ATI-W.
FOR GOVERNMENT OF URUGUAY, RIONE DEVELOPMENT.

FILING NO.750, 8579 E310.4 E318.7 7-12-44



607 208 SHAFT (IN LATHE) FOR VERTICAL WATERWHEEL SYNCHRONOUS A-C GENERATOR,
32,000-KVA, 125-RPM, 13,800-VOLT, 50-CYCLE, 48-POLE, TYPE ATI-W.
FOR GOVERNMENT OF URUGUAY, RIONE DEVELOPMENT.

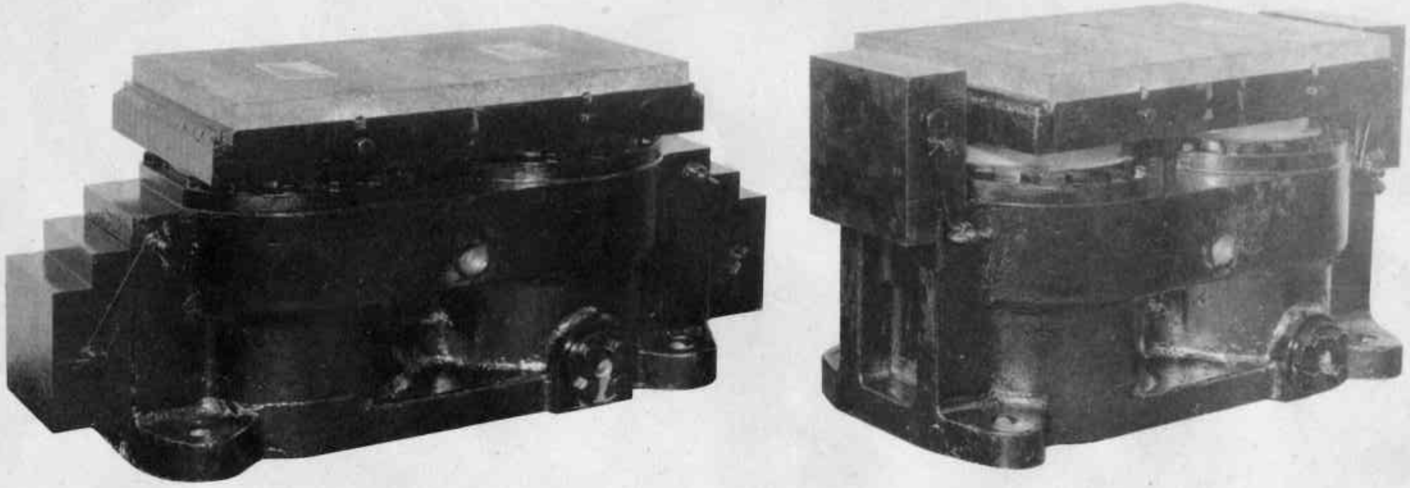
FILING NO.750, 8579 E310.4 E318.7 7-12-44



492150

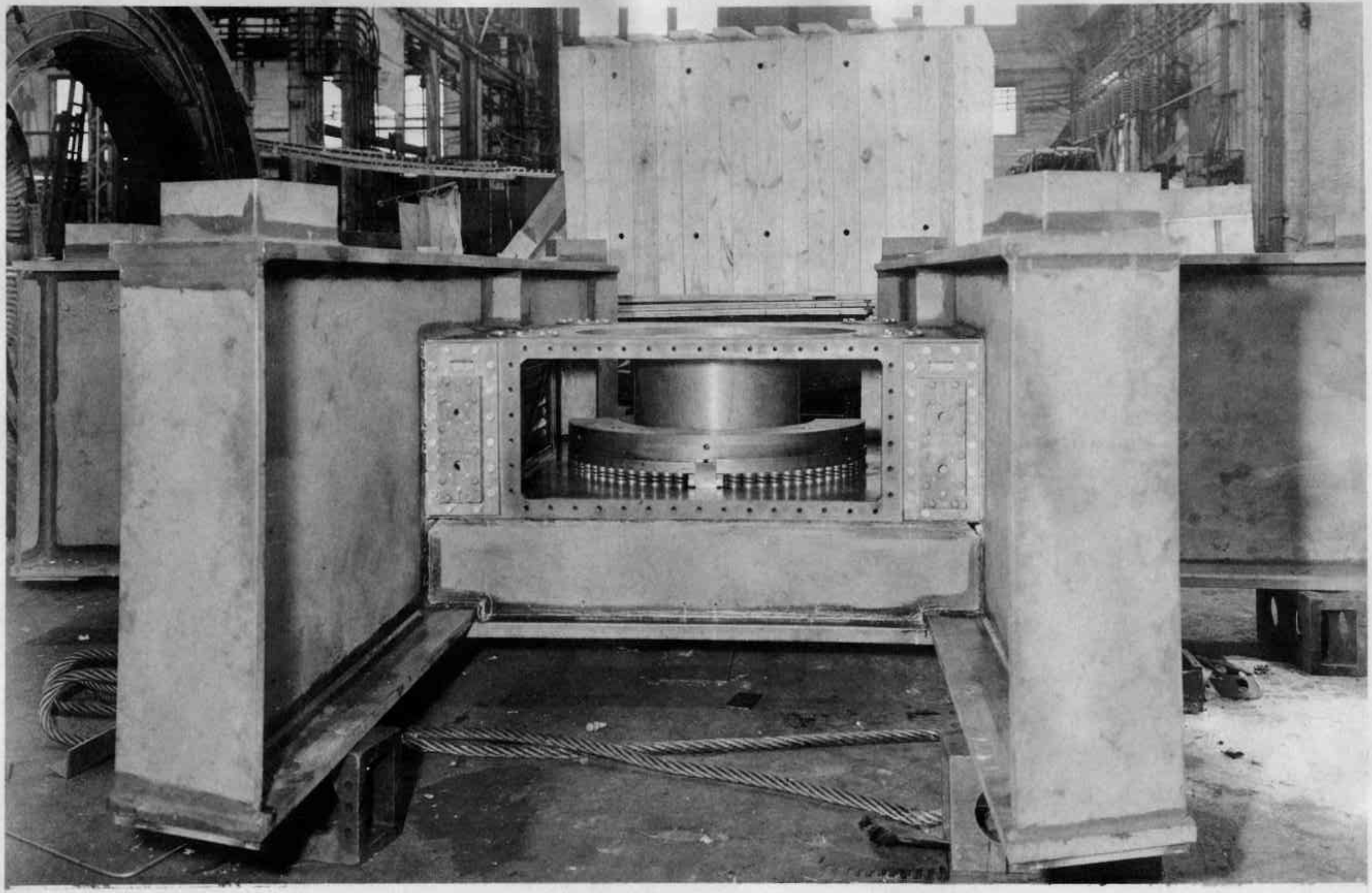
TRIAL ASSEMBLY OF POLES ON BLOCK OF RIM PUNCHINGS FOR REVOLVING FIELD FOR 1 OF 2 G-E VERTICAL A-C. WATERWHEEL GENERATORS, 82,500 KV-A., 150 RPM. 13,800 VOLTS 50 CYCLES OR 180 RPM. 16,500 VOLTS 60 CYCLES, TYPE ATI-W, 40-POLE. FOR U.S. BUREAU OF RECLAMATION FOR BOULDER DAM. REQ. D-58000.

FILING NO.750 E312.1 10-26-34



497147 COMBINED BRAKE AND JACK FOR G-E VERTICAL A-C WATERWHEEL GENERATOR, 36,000 KVA, 85.7 RPM, 13,800 VOLTS, 60 CYCLES, TYPE ATB-W, 84-POLE, FOR TENNESSEE VALLEY AUTHORITY FOR WHEELER DAM. REQ. A-80602.

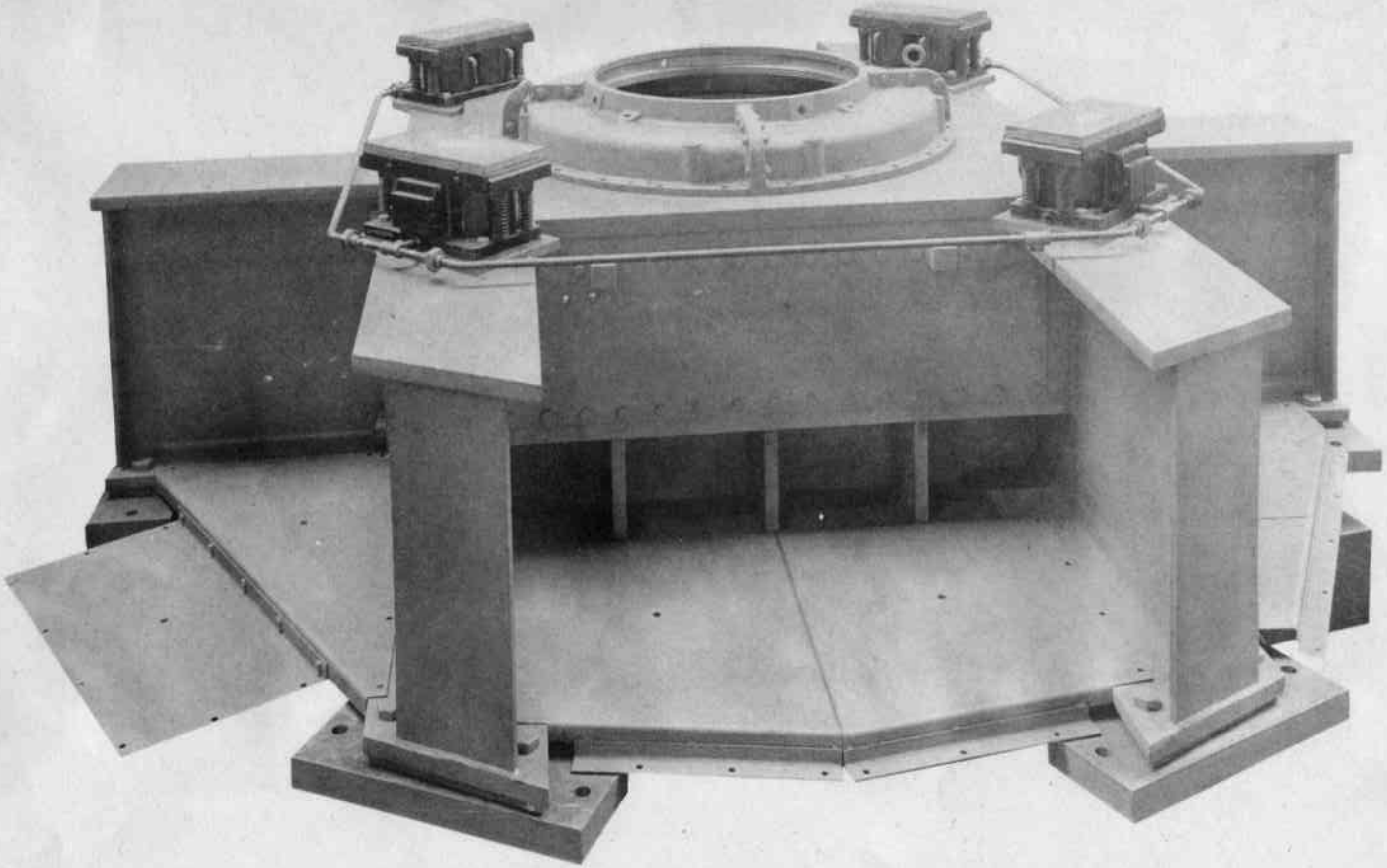
FILING NO.750 E359.1 E312.1 11-25-35



561100

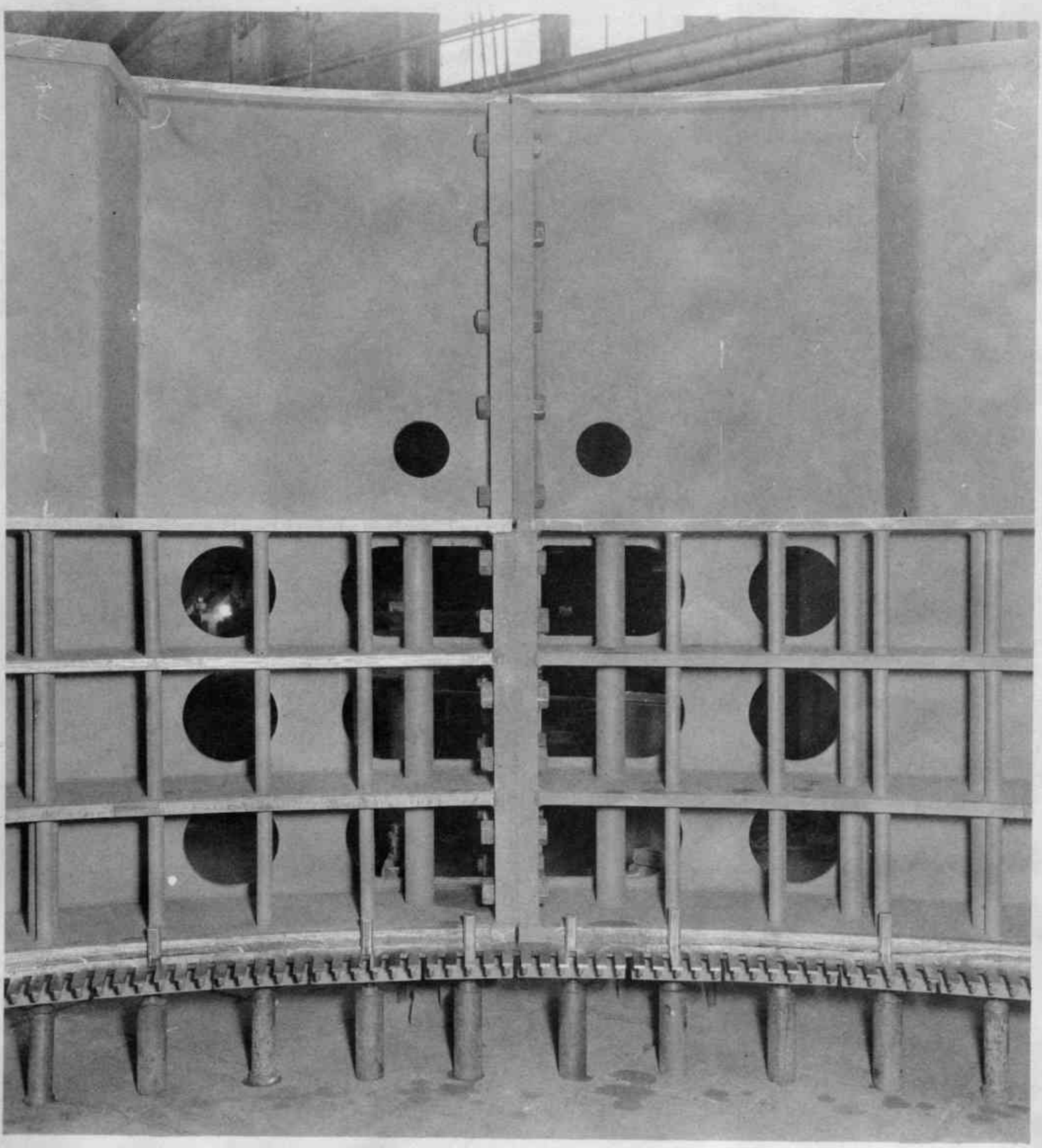
LOWER BEARING BRACKET FOR G-E VERTICAL A-C WATERWHEEL GENERATOR, 12,500 KVA, 112.5 RPM, 6900 VOLTS, 60 CYCLES, TYPE ATI-W, 64-POLE. SIDE VIEW SHOWING ARRANGEMENT OF THRUST BEARING AND OIL COOLERS. FOR LOWER COLORADO RIVER AUTHORITY. REQ. HOU-90775.

FILING NO.750 E312.1 1-5-38



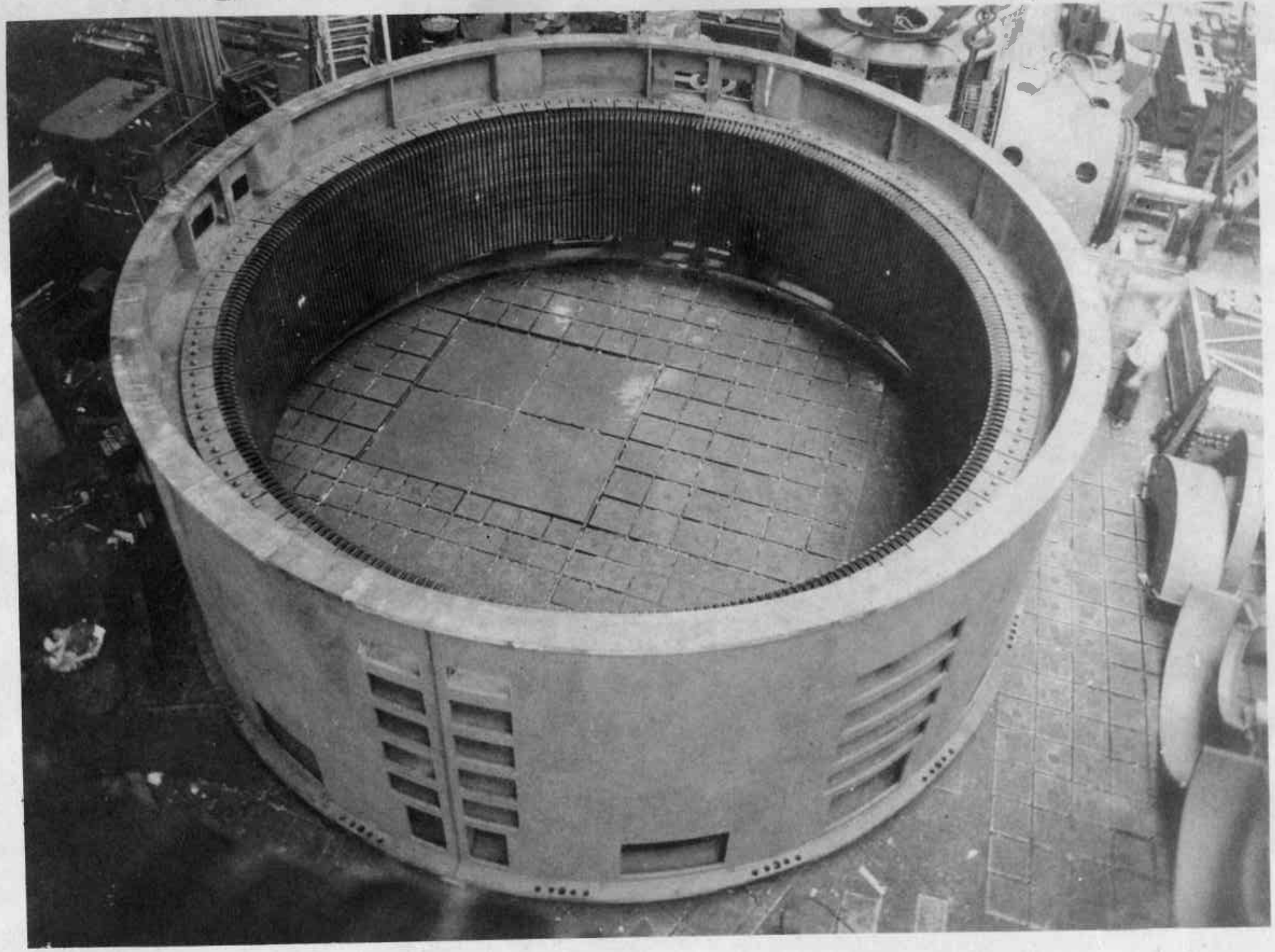
575126 LOWER BEARING-BRACKET ASSEMBLY FOR G-E SYNCHRNOUS A-C WATERWHEEL GENERATOR, 11,350 KVA, 200 RPM, 13,800 VOLTS, 60 CYCLES, TYPE ATI-W, 36-POLE. TOP OBLIQUE SIDE VIEW. FOR THE SOUTH CAROLINA PUBLIC SERVICE AUTHORITY, SANTEE-COOPER DEVELOPMENT.

FILING NO.750 E310.7 3-6-40



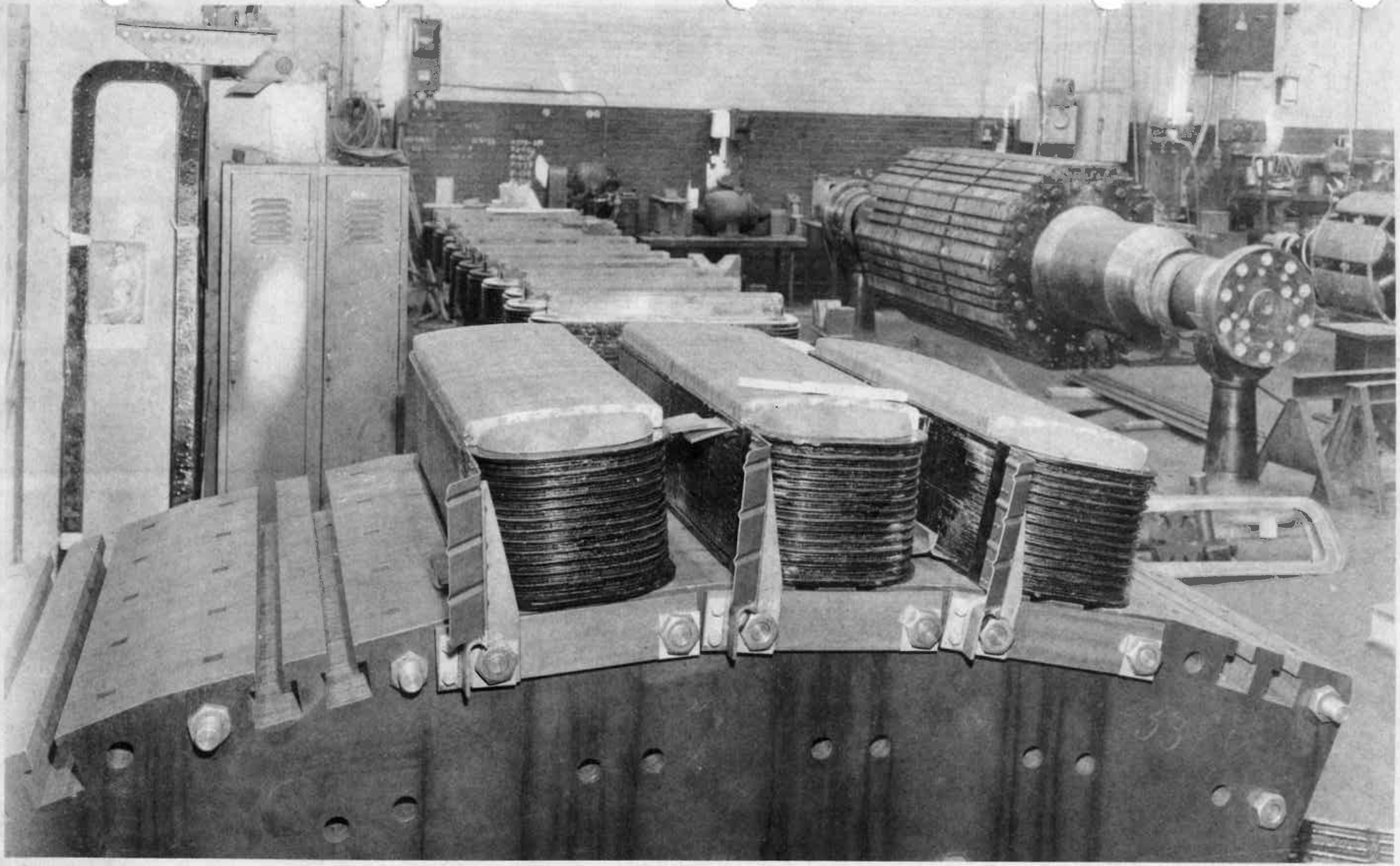
577155 JOINT IN STATIONARY-ARMATURE FRAME FOR 1 OF 2 G-E VERTICAL A-C WATERWHEEL GENERATORS, 60,000 KVA, 75 RPM, 13,800 VOLTS, 60 CYCLES, TYPE ATI-W, 96-POLE (NO.5505397) FOR U.S. ENGINEERS, BONNEVILLE POWER NAVIGATION PROJECT, REQ. XPT-91500.

FILING NO.750 E310.1 6-24-40



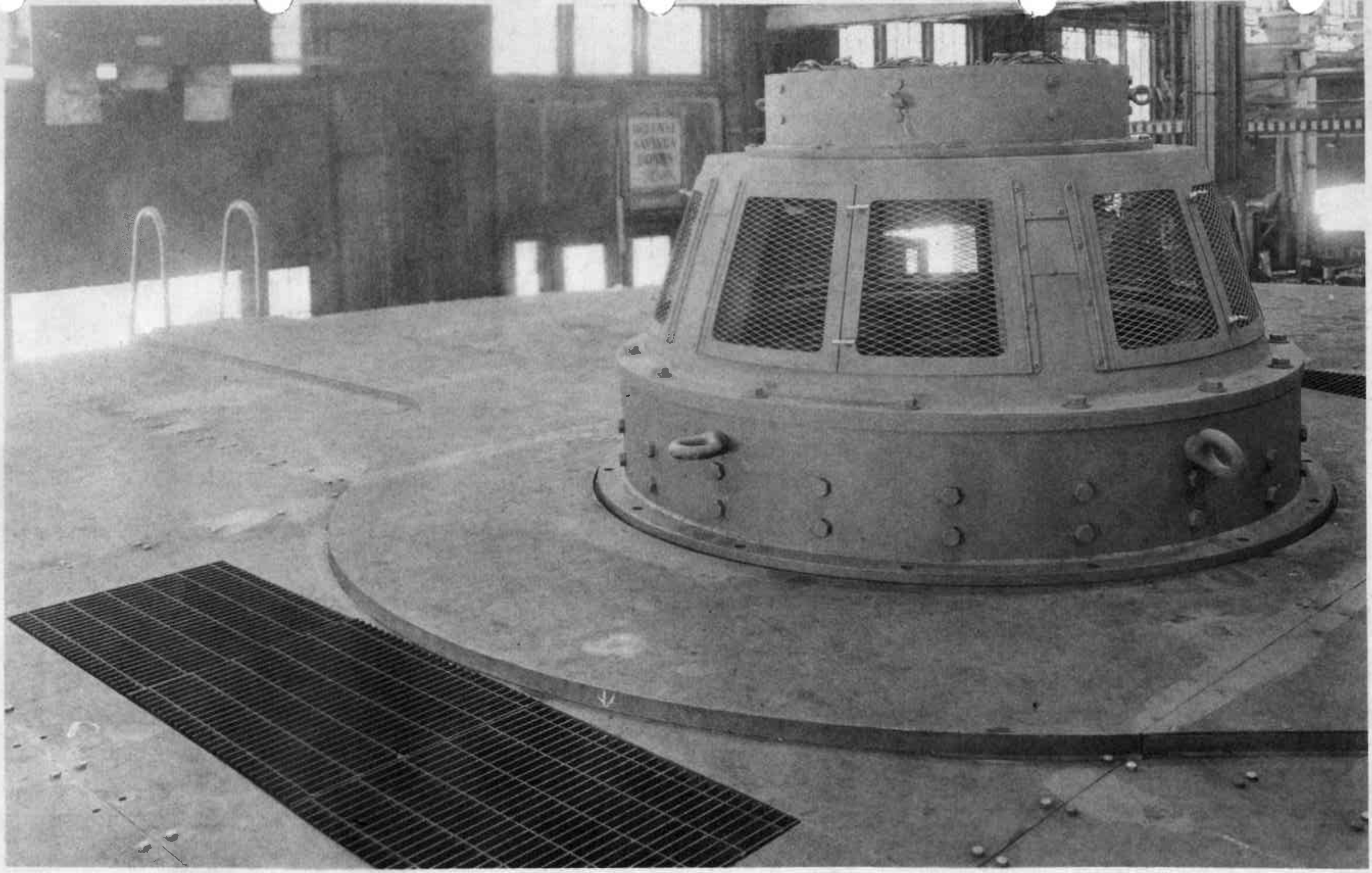
583297 UNWOUND STATIONARY ARMATURE FOR 1 OF 4 G-E VERTICAL SYNCHRONOUS A-C WATERWHEEL GENERATORS, 75,000 KVA, 138.5 RPM, 13,800 VOLTS, 60 CYCLES, TYPE ATI-W, 52-POLE. OBLIQUE TOP VIEW. FOR BUREAU OF RECLAMATION FOR SHASTA DAM, REQ.XD-6200-2/3.

FILING NO.750 E310.1 C-6-12-41



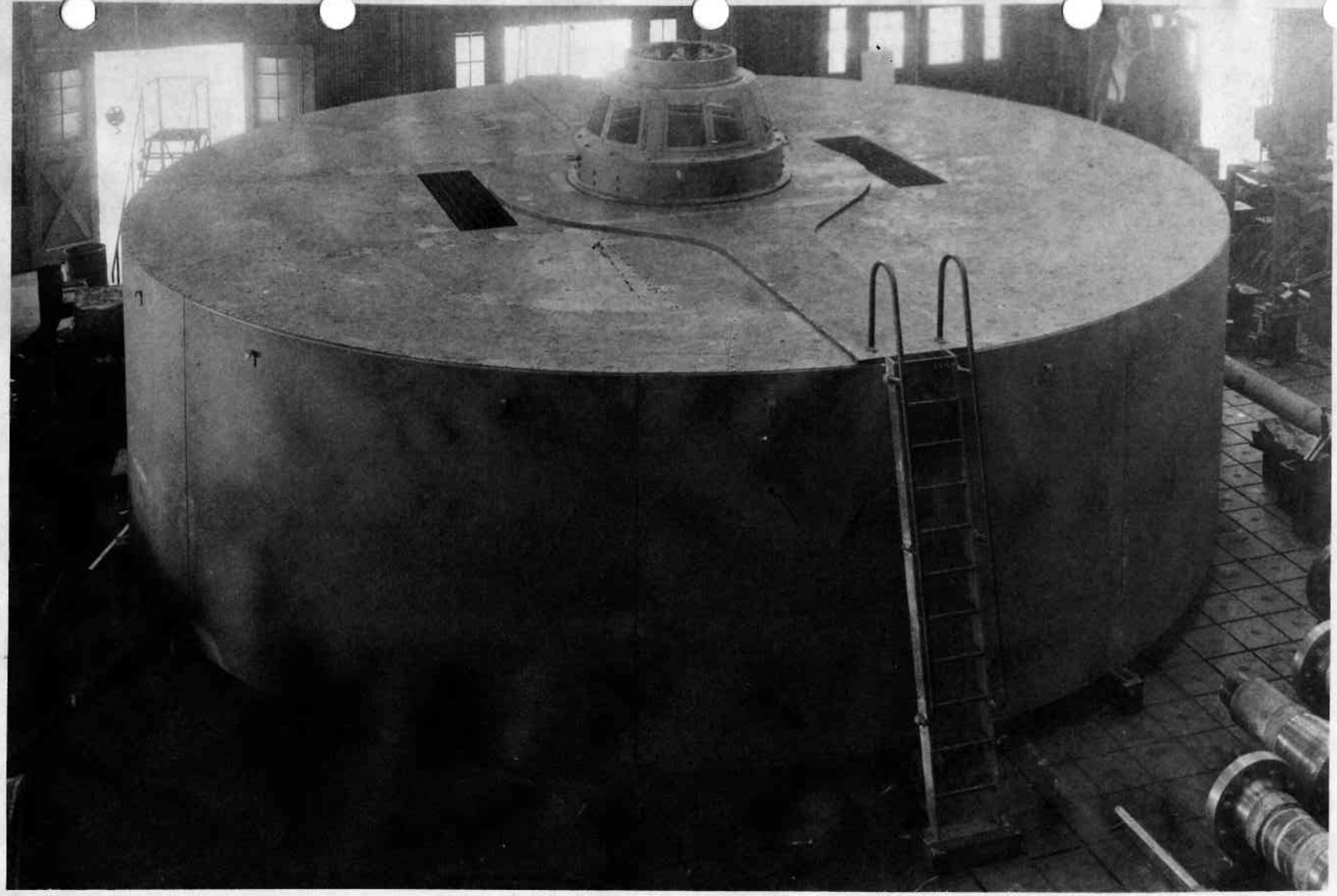
608 005 TRIAL ASSEMBLY OF REVOLVING-FIELD POLES AND FANS ON SECTION OF ROTOR SPIDER RIM FOR G-E VERTICAL WATERWHEEL SYNCHRONOUS A-C GENERATOR, 32,000-KVA, 125-RPM, 13,800-VOLT, 50-CYCLE, 48-POLE, TYPE ATI-W. FOR GOVERNMENT OF URUGUAY, RIONE DEVELOPMENT, REQ. I-56200.

FILING NO. 750 E310.4 8-9-44



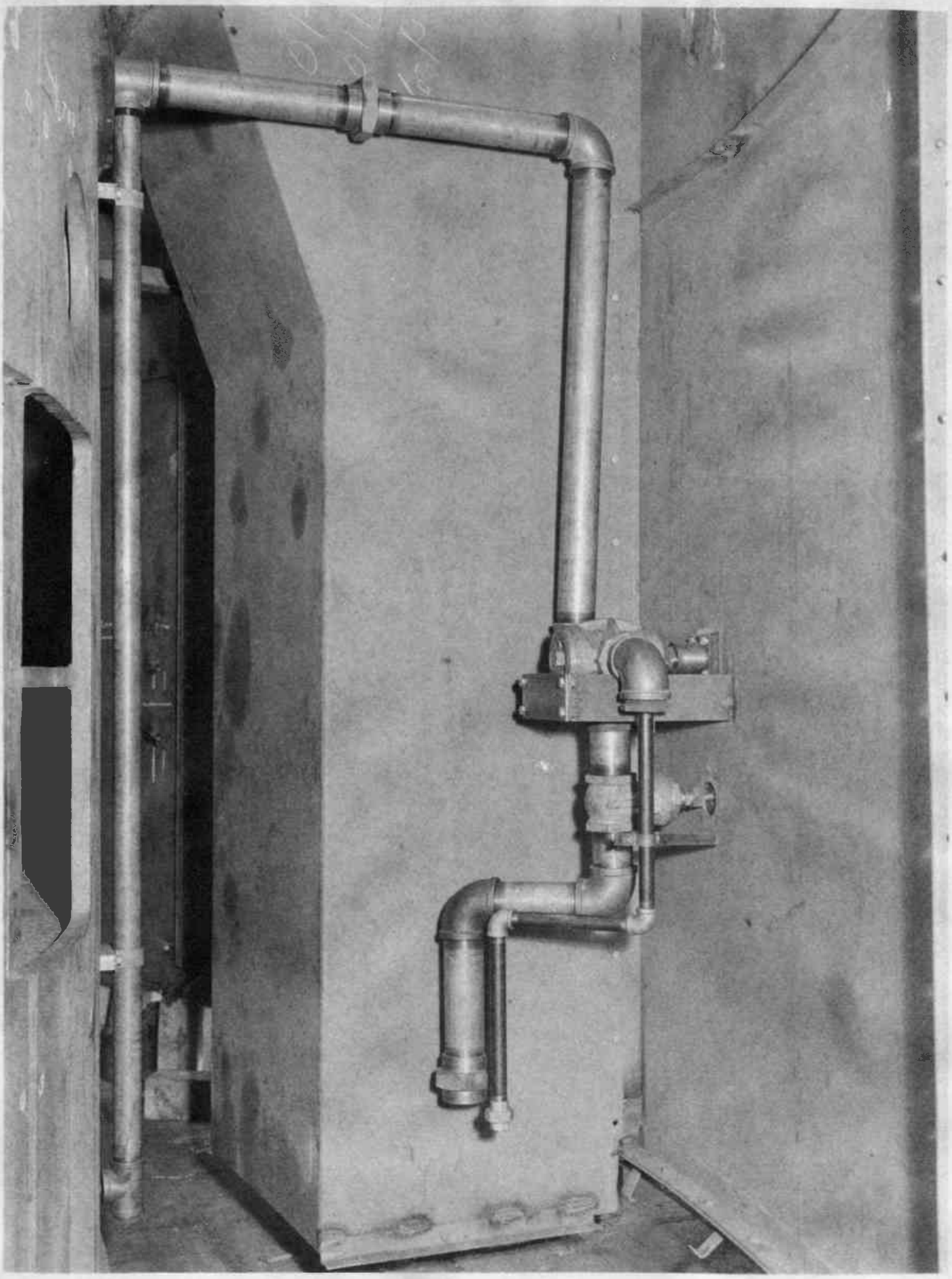
608 846 MAIN- AND PILOT-EXCITER FRAMES ASSEMBLED ATOP G-E VERTICAL WATERWHEEL A-C GENERATOR, 32,000-KVA, 125-RPM, 13,800-VOLT, 50-CYCLE, 48-POLE, TYPE ATI-W. SIDE VIEW SHOWING SUPPORT BETWEEN EXCITERS, RAISED PLATFORM AROUND EXCITERS, AND GRILLES (1 IN LEFT FOREGROUND) OVER AIR OUTLET DUCTS FOR EXCITERS. FOR GOVERNMENT OF URUGUAY, RIONE DEVELOPMENT, REQ. 1-56200.

FILING NO.750 E310.4 C-9-11-44



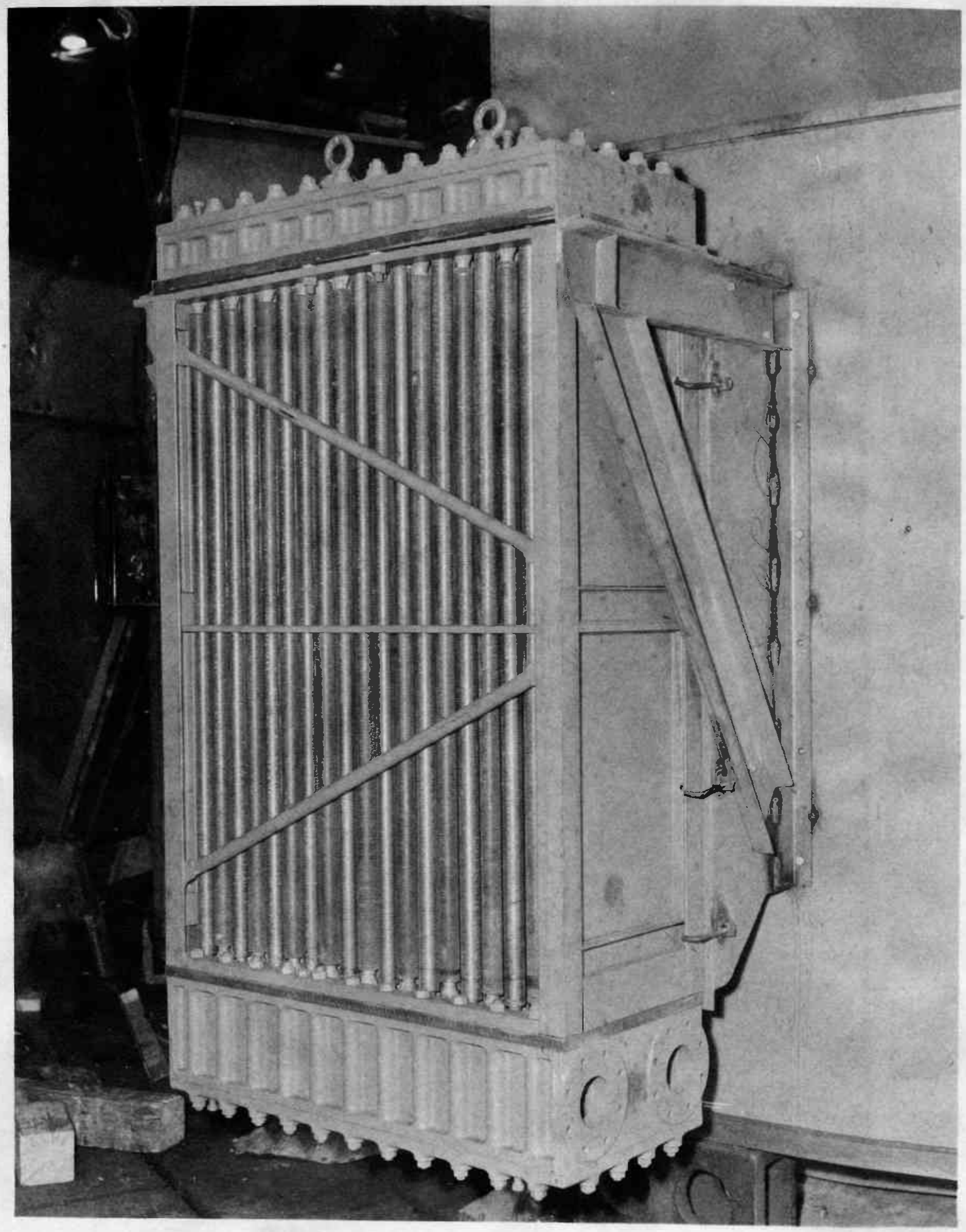
608 847 VENTILATING HOUSING ASSEMBLED (IN FACTORY) AROUND STATIONARY ARMATURE FOR G-E VERTICAL WATERWHEEL A-C GENERATOR, 32,000-KVA, 125-RPM, 13,800-VOLT, 50-CYCLE, 48-POLE, TYPE ATI-W. OBLIQUE SIDE VIEW (FROM ABOVE). FOR GOVERNMENT OF URUGUAY, RIONE DEVELOPMENT, REQ. I-56200.

FILING NO.750 E310.1 E310.6 9-11-44



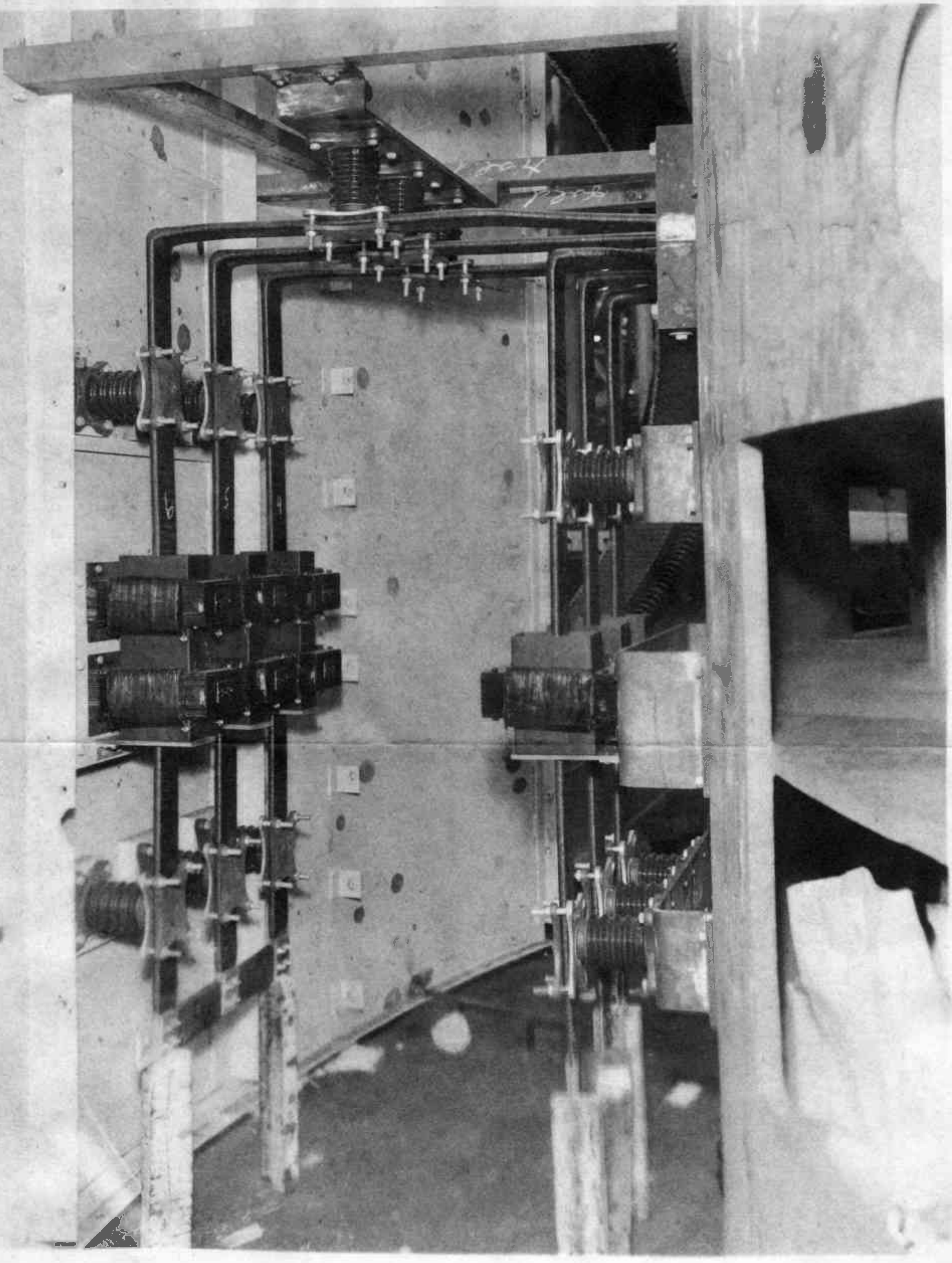
609 127 PIPING AND VALVES FOR WATER SUPPLY TO SPRINKLER SYSTEM WITH DUCT FOR "KAPLAN" PIPES IN BACKGROUND. G-E VERTICAL WATERWHEEL A-C GENERATOR, 32,000-KVA, 125-RPM, 13,800-VOLT, 60-CYCLE, 48-POLE, TYPE ATI-W. FOR GOVERNMENT OF URUGUAY, RIONE DEVELOPMENT, REQ. I-56200.

FILING NO.750 E310.1 9-21-44



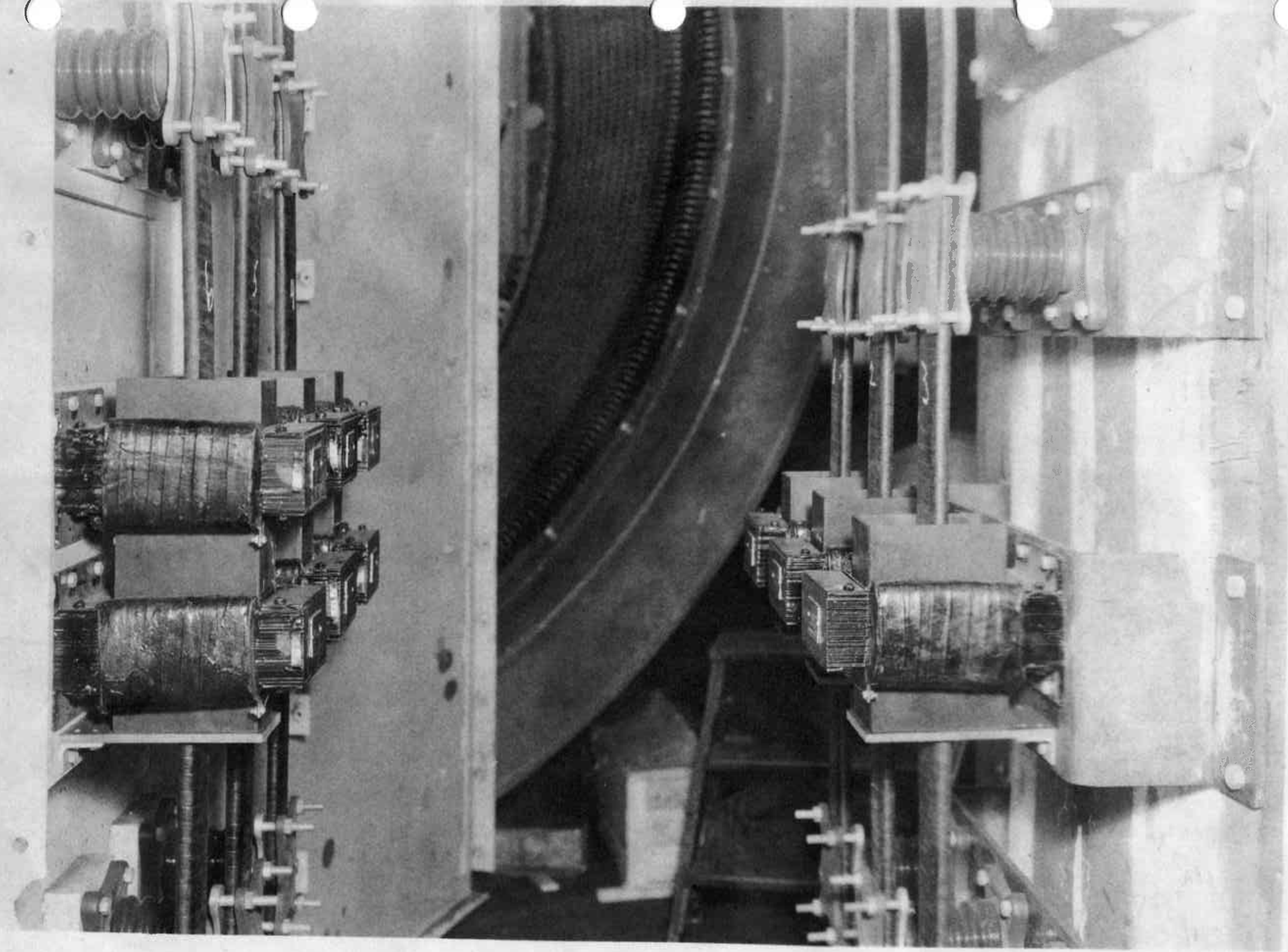
609 128 SURFACE AIR COOLER AND SUPPORT MOUNTED ON STATIONARY ARMATURE FRAME. FOR VERTICAL WATERWHEEL A-C GENERATOR, 32,000-KVA, 125-RPM, 13,800-VOLT, 50-CYCLE, 48-POLE, TYPE ATI-W. FOR GOVERNMENT OF URUGUAY, RIONE DEVELOPMENT, REQ. I-56200.

FILING NO.750, 420 E310.1 E560 9-21-44



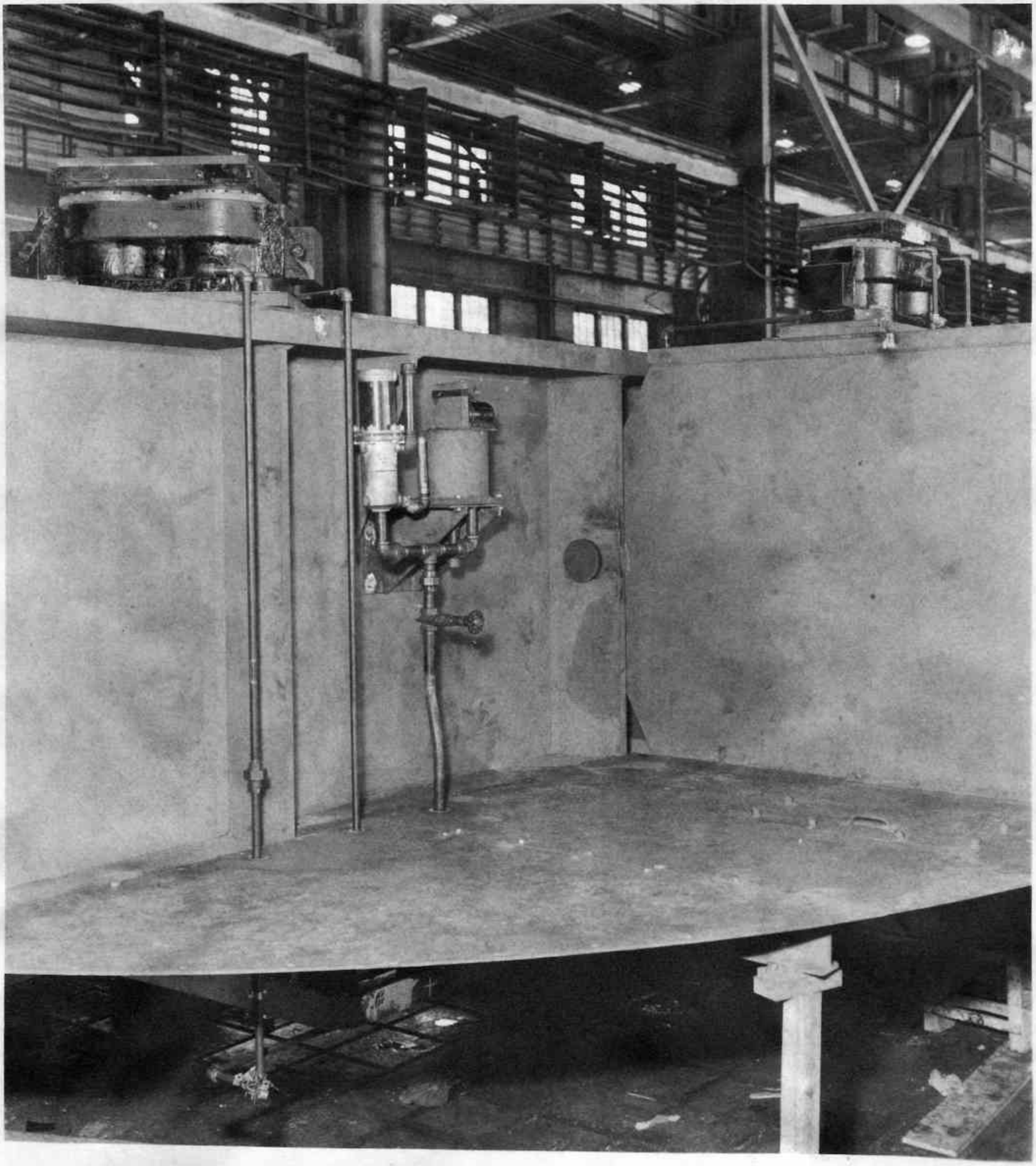
610 050 CURRENT TRANSFORMERS IN MAIN AND NEUTRAL LEADS LOCATED BETWEEN ARMATURE FRAME AND VENTILATING HOUSING, FOR G-E VERTICAL WATERWHEEL SYNCHRONOUS A-C GENERATOR, 32,000-KVA, 125-RPM, 13,800-VOLT, 3-PHASE, 50-CYCLE, 48-POLE, TYPE ATI-W. FOR GOVERNMENT OF URUGUAY, RIONE DEVELOPMENT, REQ. 1-56200.

FILING NO.750, 6400 E310.1 E310.6 E331.4 10-18-44



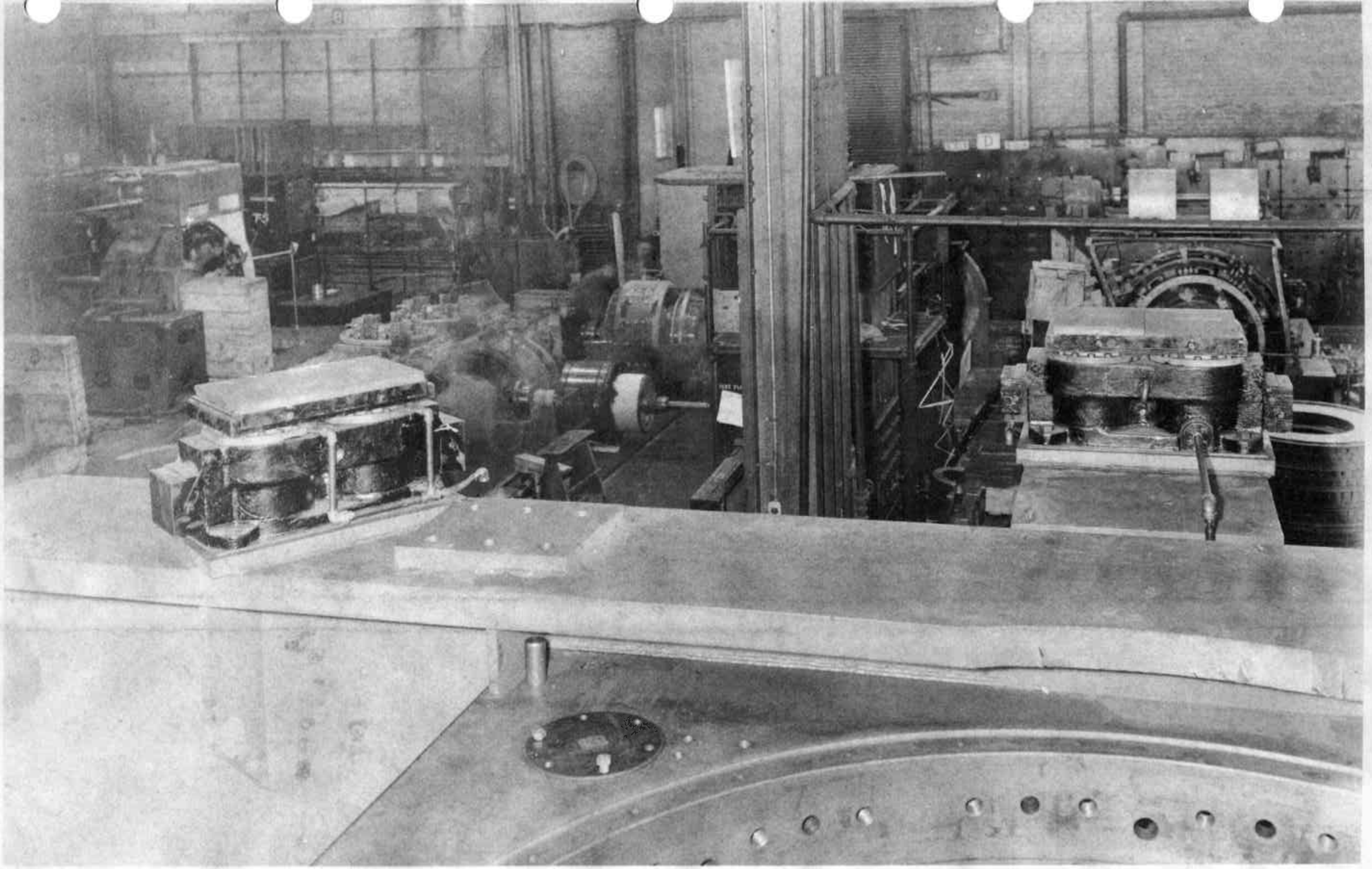
610 051 CURRENT TRANSFORMERS IN MAIN AND NEUTRAL LEADS LOCATED BETWEEN ARMATURE FRAME AND VENTILATING HOUSING, FOR G-E VERTICAL WATERWHEEL SYNCHRONOUS A-C GENERATOR, 32,000-KVA, 125-RPM, 13,800-VOLT, 3-PHASE, 50-CYCLE, 48-POLE, TYPE ATI-W. FOR GOVERNMENT OF URUGUAY, RIONE DEVELOPMENT, REQ. I-56200.

FILING NO.750, 6400 E310.1 E310.6 E331.4 10-16-44



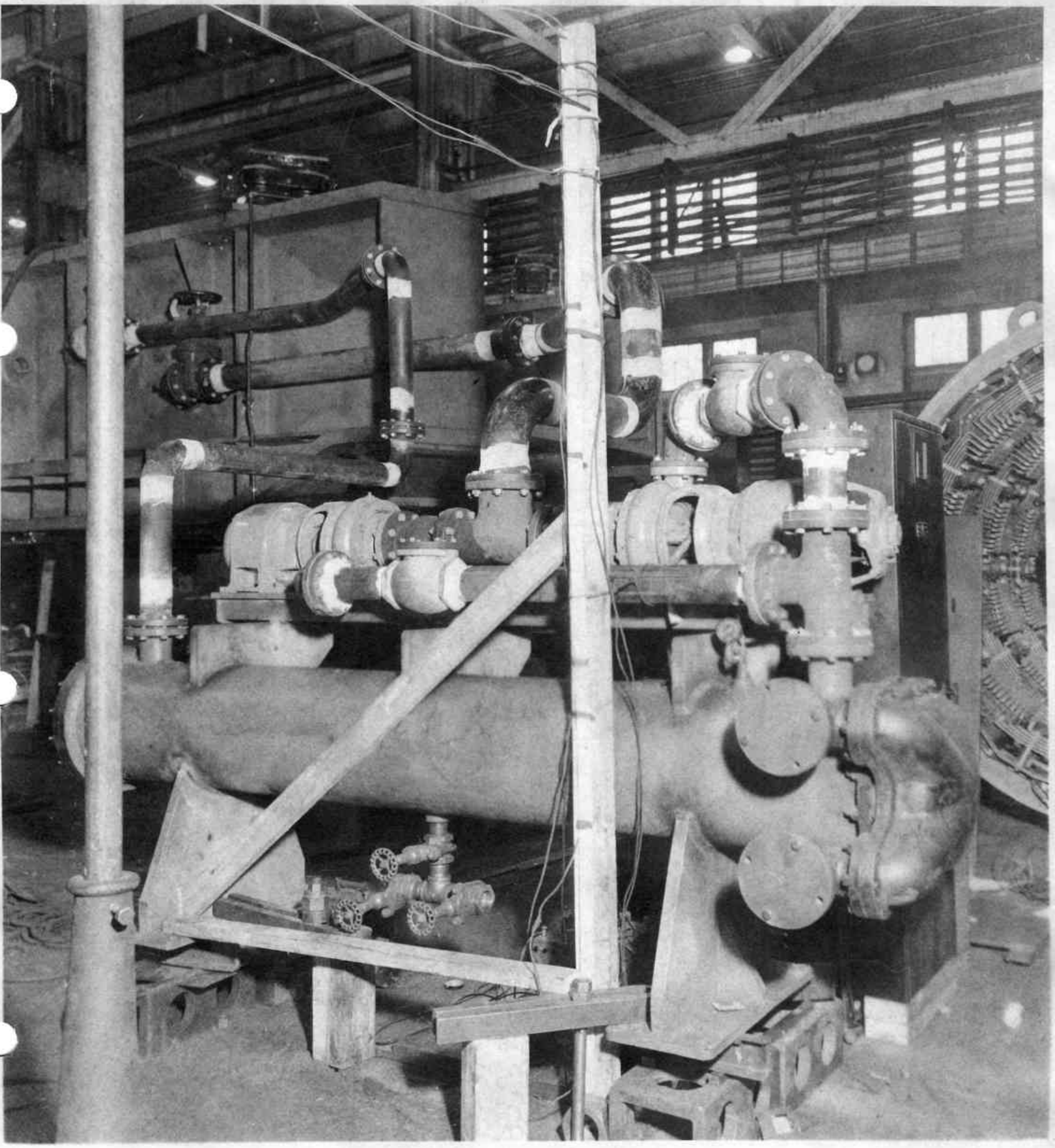
610 377 LOWER BEARING BRACKET FOR G-E VERTICAL WATERWHEEL SYNCHRONOUS A-C GENERATOR, 32,000-KVA, 125-RPM, 13,800-VOLT, 50-CYCLE, 48-POLE, TYPE ATI-W. CLOSE-UP VIEW SHOWING METHOD OF ASSEMBLING BRAKES AND JACKS AND OIL-LEVEL INDICATORS. FOR GOVERNMENT OF URUGUAY, RIONE DEVELOPMENT, REQ.1-56200.

FILING NO.750 E310.7 10-30-44



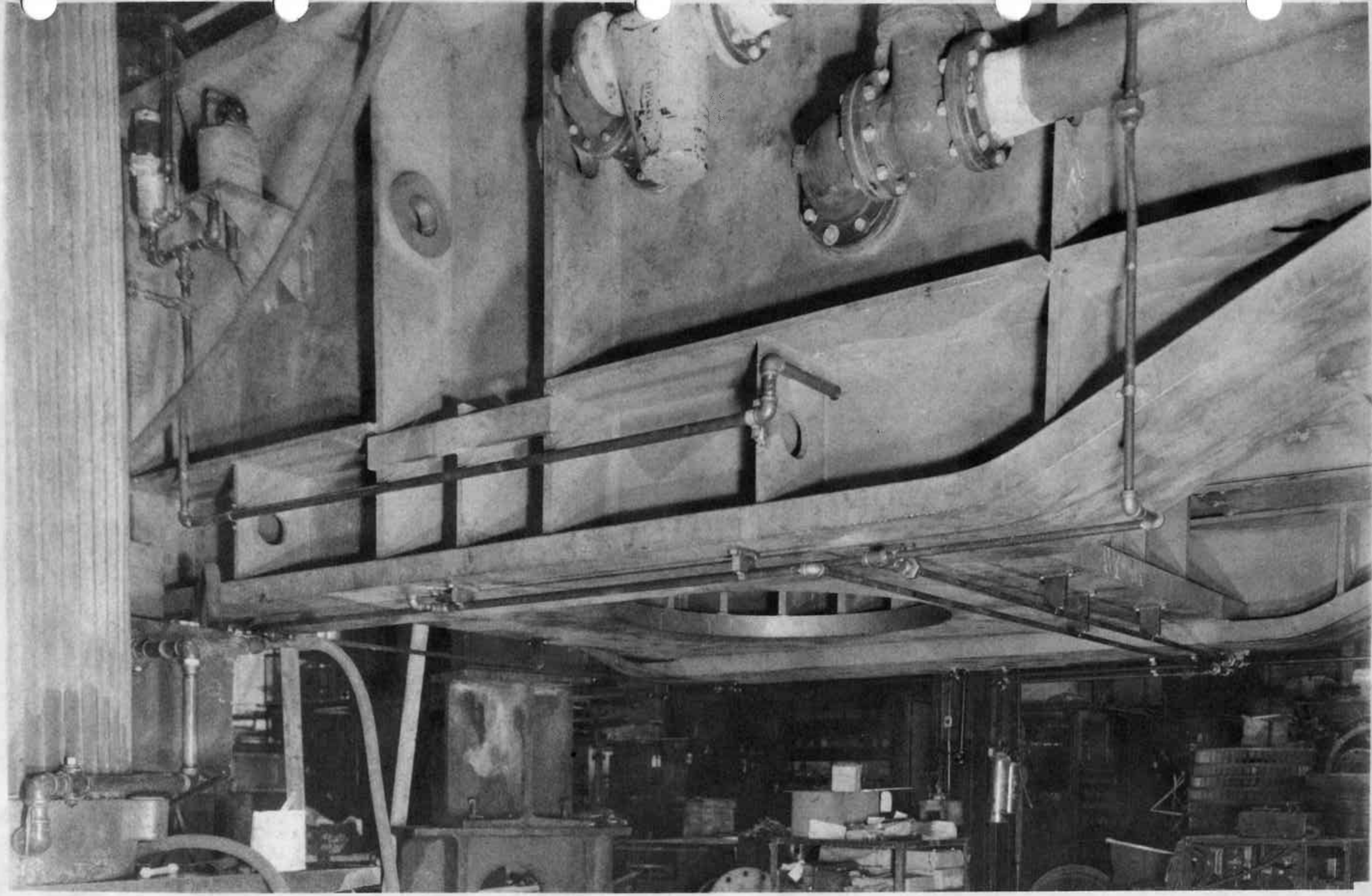
610 378 LOWER BEARING BRACKET FOR G-E VERTICAL WATERWHEEL SYNCHRONOUS A-C GENERATOR, 32,000-KVA, 125-RPM, 13,800-VOLT, 50-CYCLE, 48-POLE, TYPE ATI-W. CLOSE-UP VIEW SHOWING LOWER GUIDE BEARING SUPPORT AND ASSEMBLED BRAKES AND JACKS. FOR GOVERNMENT OF URUGUAY, RIONE DEVELOPMENT, REQ. I-56200.

FILING NO. 750 E310.7 10-30-44



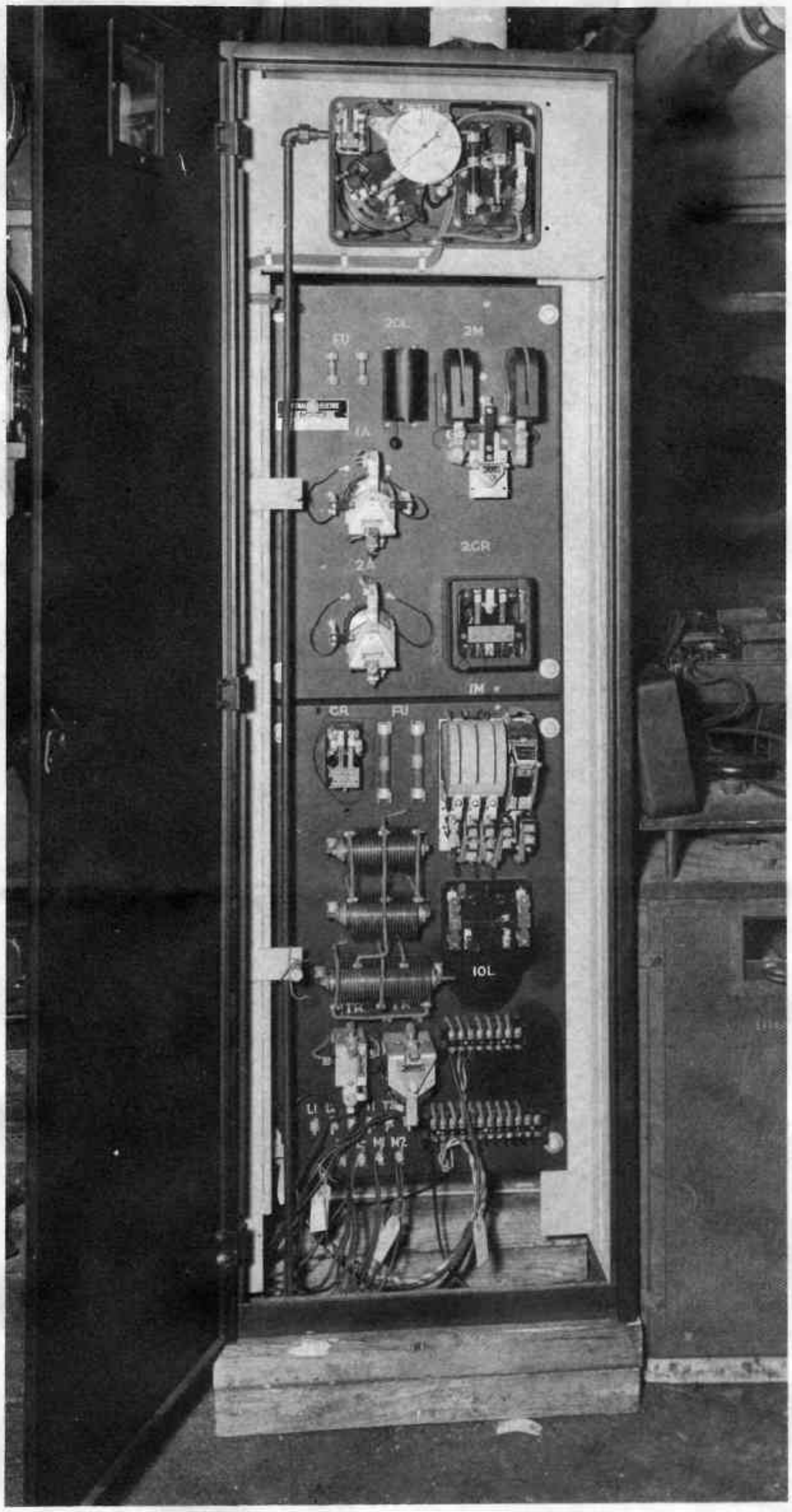
610 769. OIL COOLER, MOTOR-DRIVEN OIL PUMPS AND PIPING BETWEEN COOLER AND BEARING HOUSING, FOR G-E VERTICAL WATERWHEEL SYNCHRONOUS A-C GENERATOR, 32,000-KVA, 125-RPM, 13,800-VOLT, 50-CYCLE, 48-POLE, TYPE ATI-W. PART OF LOWER BEARING BRACKET VISIBLE IN CENTER LEFT. FOR GOVERNMENT OF URUGUAY, RIONE DEVELOPMENT. REQ. 1-56200.

FILING NO. 350 E55C E310.7 11-9-44



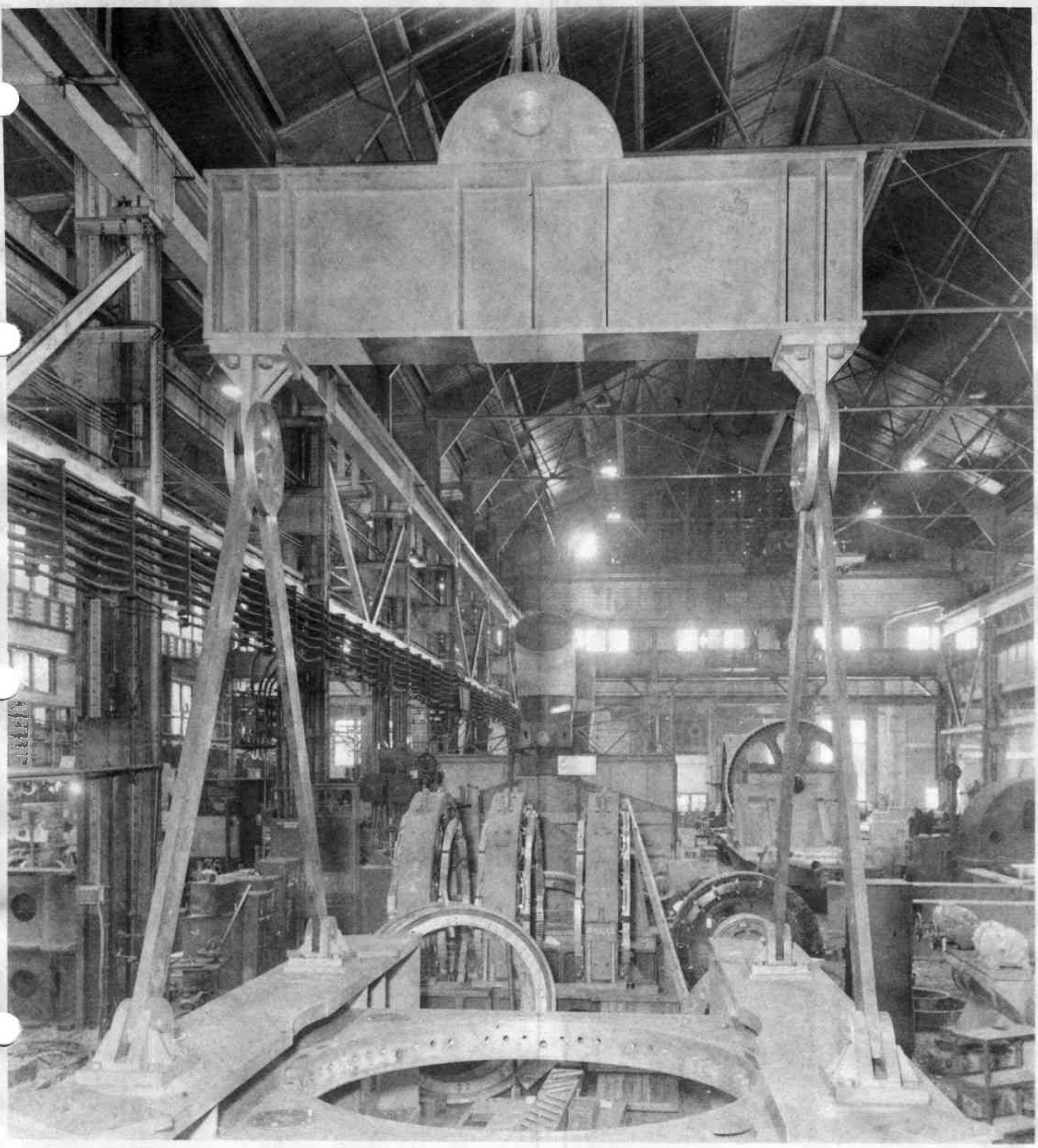
610 770 LOWER BEARING BRACKET FOR G-E VERTICAL WATERWHEEL SYNCHRONOUS A-C GENERATOR, 32,000-KVA, 125-RPM, 13,800-VOLT, 50-CYCLE, 48-POLE, TYPE ATI-W. CLOSE-UP VIEW SHOWING PART OF BRAKE PIPING, OIL PIPING AND OIL LEVEL INDICATING DEVICES. FOR GOVERNMENT OF URUGUAY, RIONE DEVELOPMENT. REQ. I-56200.

FILING NO. 750 E310.7 11-9-44



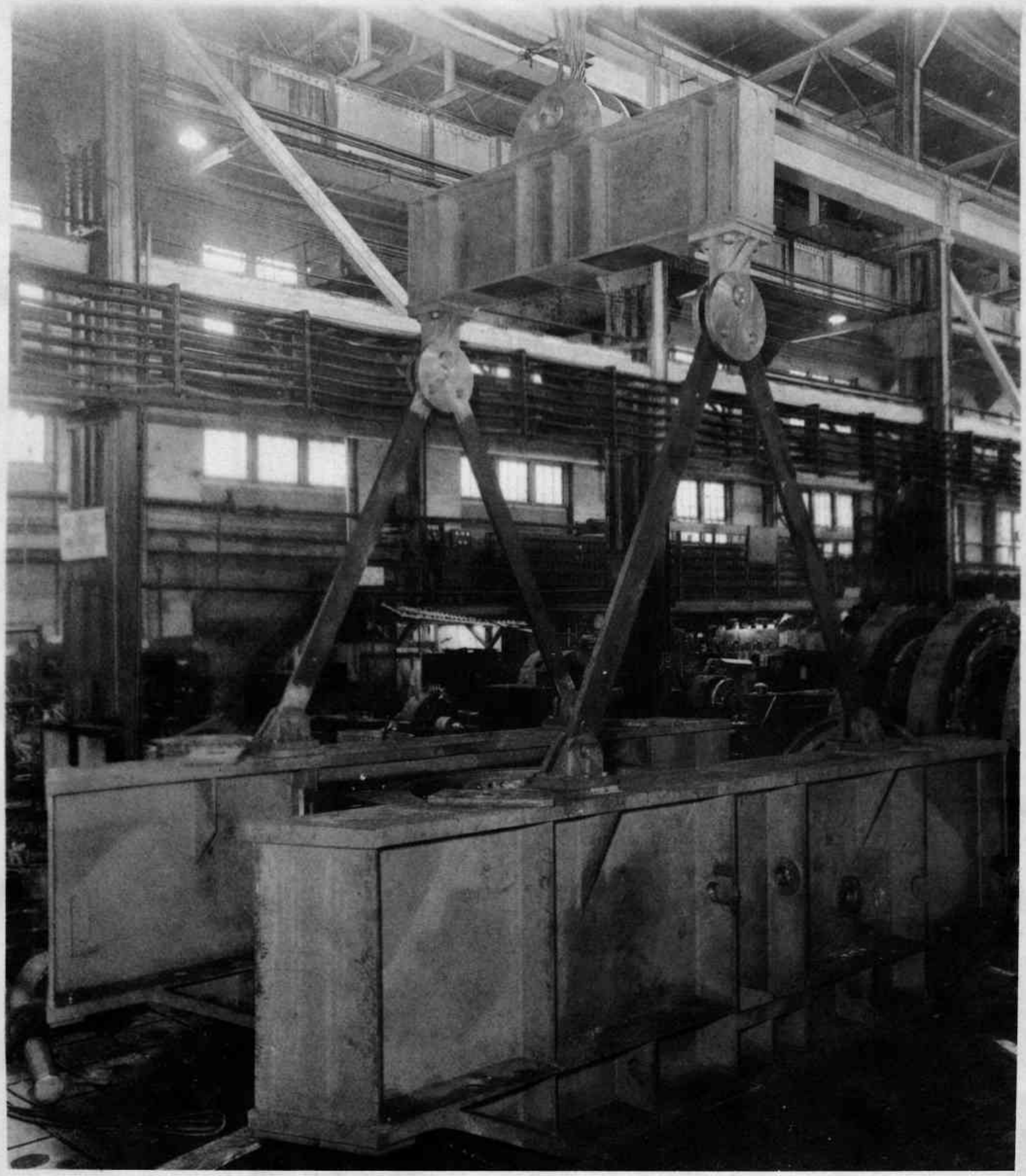
610 771 G-E CONTROL PANEL, CR7890-Y1, FOR CIRCULATING-OIL PUMPS, FOR G-E VERTICAL WATERWHEEL SYNCHRONOUS A-C GENERATOR, 32,000-KVA, 125-RPM, 13,800-VOLT, 50-CYCLE, 48-POLE, TYPE ATI-W. DOOR OPEN. FRONT VIEW. FOR GOVERNMENT OF URUGUAY, RIONE DEVELOPMENT. REQ. I-56200.

FILING NO. 750, 8920-7890 E353.2 11-9-44



610 860 LIFTING BEAM AND LINKS FOR LOWER BEARING BRACKET FOR G-E VERTICAL WATERWHEEL SYNCHRONOUS A-C GENERATOR, 32,000-KVA, 125-RPM, 13,800-VOLT, 50-CYCLE, 48-POLE, TYPE ATI-W. FOR GOVERNMENT OF URUGUAY, RIONE DEVELOPMENT, REQ.I-56200.

FILING NO.750, 8498 E310.7 E856 11-13-44



610 861 LIFTING BEAM AND LINKS FOR LOWER BEARING BRACKET FOR G-E VERTICAL WATERWHEEL SYNCHRONOUS A-C GENERATOR, 32,000-KVA, 125-RPM, 13,800-VOLT, 50-CYCLE, 48-POLE, TYPE ATI-W. FOR GOVERNMENT OF URUGUAY, RIONE DEVELOPMENT, REQ. I-56200.

FILING NO. 750, 8498 E310.7 E856 11-13-44